



HIGH PERFORMANCE CONCRETE FOR PRECAST BRIDGE UNITS MSP-97-04K

1.0 Description. This specification covers materials and construction requirements for producing and placing a high performance concrete mixture for precast bridge units.

1.1 All materials and construction procedures shall meet MoDOT specifications and specifically the applicable requirements listed in [Sec 1029](#) except as noted herein.

1.2 Final design strength and release strength shall be as indicated on the plans.

2.0 Concrete Mixture Requirements.

2.1 The maximum water cement ratio by weight, including all cementitious materials (cement, fly ash, silica fume, ground granulated blast furnace slag) and water components, is not limited for the submitted design.

2.2 The minimum cement factor, including all cementitious materials, shall be 6.4 sacks (360 kg) per cubic yard (m^3) with no specified maximum.

2.3 The air content shall be 6.0 percent, plus 2.0 or minus 1.5 percent.

2.4 Slump shall not exceed 8 inches (200 mm).

2.5 The mix shall attain final design strength by 56 days. Strengths may be obtained earlier.

2.6 Chloride permeability at design strength (irregardless of age) shall not be greater than 1000 coulombs when tested in accordance with AASHTO T 277. This test shall be performed on each mixture submitted for approval and at least once during production as designated by the engineer. The test is to be performed by a qualified commercial laboratory and results furnished to the engineer by the precaster.

3.0 Materials. Precaster selected and engineer approved combinations of coarse aggregate, fine aggregate, water reducer (high or low range), other approved additives, cement, fly ash, ground granulated blast furnace slag (GGBFS), or silica fume may be used. No proprietary mixtures will be allowed. All materials shall be compatible and approved. A statement from each supplier of silica fume or GGBFS and all other admixtures (not fly ash) including air entrainment shall be provided, listing and identifying all materials to be used, with indicated supplier concurrence that their material is compatible and recommended for use with those listed.

3.1 Coarse aggregates shall be limestone or porphyry aggregate meeting the requirements of [Sec 1005](#) for pavement aggregate quality and the deleterious substance requirements listed in [Sec 505.10.2.1](#).

3.2 Silica fume material and usage shall meet applicable portions of [Sec 505.30](#) concerning material and mixing and shall be added in accordance with manufacturer's recommendations, except that silica fume shall be limited to 6.0 - 8.0 percent of the cement weight.

3.3 Cementitious material, other than cement, may be bagged into the mixer unit provided done uniformly and expeditiously. Repulpable sacks shall not be used.

3.4 Cementitious material content shall be limited as noted in [Sec 501](#) and [505.30](#), including maximum 15 percent fly ash and 25 percent GGBFS, except as noted herein. Silica fume and GGBFS may be intermixed, with a statement of compatibility and recommendation from the supplier. Type III cement may be used. Replacement of cement with other cementitious material shall not exceed 25 percent total by weight.

3.5 High range water reducers may be used and shall be previously approved for use in accordance with [Sec 1054](#).

3.6 With approval of the engineer, other gradations of coarse or fine aggregate may be used, however all quality requirements, including a maximum of 2.0 percent passing the No. 200 (75 μ m) for fine and coarse aggregate, shall apply and the maximum aggregate size shall not exceed that of [Sec 1005](#), Grade E aggregate.

3.7 Admixtures containing calcium chloride shall not be used.

4.0 Mix Design. The precaster shall submit and specify the specific materials, mix design, designated slump, air content, and water/cement ratio within the limits of this provision. Actual test results on concrete made and cured in accordance with the submitted design and intended procedures shall be included, including air, slump, and strengths of cylinders at 24 hour intervals up to 7 days minimum and final design strength. Results of chloride permeability tests on concrete from those batches shall also be furnished. The above information will be required for each variation of water/cement ratio desired, as well as any major changes in material proportioning.

4.1 The precaster shall also designate the mixing sequence and mixing times. All concrete shall be placed within a maximum of 60 minutes from the beginning of mixing operations and no greater than 15 minutes later than the time designated by the contractor and used for the trial batch.

4.2 If other aggregate gradations than standard specifications are utilized, the precaster shall designate the intended gradation range, which will be used for inspection and quality control of the aggregates.

5.0 Equipment. The precaster shall be responsible for furnishing calibrated equipment for cylinder breaks either in the plant or by using an approved commercial laboratory. The equipment capacity should exceed the anticipated loading by 50 percent. Approved high strength sulfur compound designed for use in the actual strength range shall be used for capping.

6.0 Construction Requirements.

6.1 In addition to any preliminary mix design work, after the concrete mixture is approved and prior to starting project unit casting, the precaster shall make a minimum of a 3 cubic yard (2 m³) trial batch in the same manner as intended for the final units to demonstrate proper batching, placement, finishing and curing of the concrete. The trial batch shall replicate all actual casting conditions including materials, times, equipment, and personnel. All required tests shall be performed and the concrete shall meet all specifications prior to start of initial casting. More than one trial batch may be required in the event that mix or process changes are necessary or specifications are not met. New trial batches will not be required for changes in water content for previously approved mix designs.

6.2 Mixture tests, sequencing, and times during production shall not exceed those limits specified by the precaster in the approved mix design or those listed herein.

6.3 Total mix air content shall not be less than that designated in the approved mix design, nor exceed that value by more than 3.5 percentage points.

6.4 Slump shall not exceed 8 inches (200 mm) and shall be within 2 inches (50 mm) of that specified in the approved mix design.

6.5 The water/cement ratio shall be within 0.020 of that specified in the approved mix design. If adjustments for water content beyond that are necessary, a previously tested and approved mixture shall be used.

6.6 Compressive tests for release and final design strengths shall be performed on 6 x 12 inch (152 x 305 mm) cylinders cured in the same manner as the precast, prestressed units as the final indicator of strength compliance. As an alternate, the precaster may use 4 x 8 inch (102 x 203 mm) cylinders for determining strength to release and final design strength to cease cure, provided companion made and cured 6 x 12 inch (152 x 305 mm) cylinders shipped to the MoDOT central laboratory for ASAP testing after the same curing time are of equal or greater value.

6.7 No redosage of high range water reducer or other additives shall be done. Additional mixing water may be added only once after the initial mixing process and prior to any consequential discharge, in which case an additional 30 revolutions at mixing speed is required. All subsequent concrete in that load not meeting the air, slump, or other requirements shall be discarded and the remainder of the load rejected. No retempering, waiting, or other measures shall be used to obtain specification compliance. These requirements shall not be used to modify the required maximum of 30 minutes between lifts.

6.8 Continuous wet curing in accordance with [Sec 1029](#) is required until final design strength is attained.

6.9 Some time prior to completion of 50 percent of the units as designated by the engineer, the precaster shall provide the engineer with a core from a precast unit, or a cylinder representing a unit of production, immediately after final design strength is attained, for chloride permeability testing.

6.9.1 If the chloride permeability result is greater than specified herein, all units for that day's production shall be cored by the precaster and will be tested by the engineer. A minimum of three units shall be cored, possibly including immediately prior or subsequent day's production if necessary to get the minimum number. If the average is less than specified, no further testing is required.

6.9.2 If the average of the three cores is greater than that specified, any unit with a test result greater than that specified is rejected without further testing and all other non-tested units shall be cored and tested by the precaster for chloride permeability at a qualified commercial laboratory, and shall meet the specifications prior to acceptance of each unit. Additional companion samples will be required by the engineer for MoDOT testing.

6.9.3 Testing of a subsequent improved mixture design may be used to eliminate testing of future individual units cast with the improved design.

6.10 For units cast using the invert process of integrally casting beams and deck simultaneously, the following shall also apply:

6.10.1 No units shall have any cracks greater than 2 inches (50 mm) in depth, prior to shipment to the project site. If any cracks are visible to the naked eye under any conditions, the engineer may require coring by the precaster at any crack location as necessary to establish a crack depth. Those units with any cracking greater than 2 inches (50 mm) in depth are automatically rejected without recourse.

6.10.2 No splatter of concrete is allowed on any steel or other exposed portions of the precast units. All exposures shall be protected completely during casting by plastic or other suitable wrapping material. Coating with any liquid material is not allowed. In the event that splatter does occur and is not completely and totally removed by wiping, the splatter shall be completely removed by sandblasting or other vigorous methods and the original condition of the exposed surface returned, with positively no residue.

7.0 Method of Measurement. No measurement will be made for high performance concrete for precast bridge units.

8.0 Basis of Payment. High performance concrete for precast bridge units will be paid for at the contract unit price for other items and will be considered full compensation for all labor, equipment and material to complete the described work.